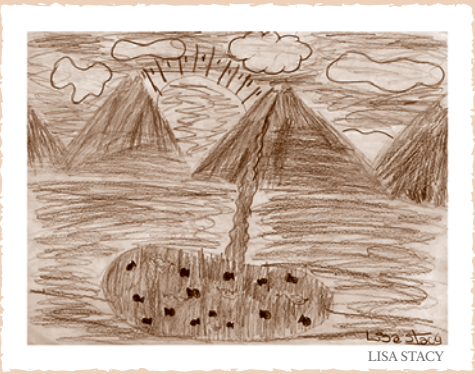

LISA STACY

FIELD TRIP

Heat, Light and Sound

Theme
The properties of heat, light, and sound can be readily observed in the natural environment.

Utah State Science Core Curriculum Topic
Standard Six: Students will understand properties and behavior of heat, light, and sound.

Objective One: Investigate the movement of heat between objects by conduction, convection, and radiation.

Objective Two: Describe how light can be produced, reflected, refracted, and separated into visible light of various colors.

Objective Three: Describe the production of sound in terms of vibration of objects that create vibrations in other materials.

Field Trip Location
Any riparian corridor with a perennial stream. As long as at least some of the area is surrounded by natural habitat. Suggested areas include, Courthouse Wash in Arches National Park; Mill Creek Canyon near Moab; or Negro Bill Canyon along Highway 128 near Moab.

Times
Pre and post trip lessons and Field trip stations are 30 minutes each.

Science Language Students Should Use
Angle of incidence, angle of reflection, absorption, conduction, conductor, convection, medium, pitch, prism, radiation, reflection, refraction, spectrum, vibration

Background

Energy is transported around the universe in the form of waves. Sound waves, light waves, ocean waves, heat waves, and radio waves are some examples. The shape of the wave determines its characteristics. The *amplitude* is the height of the wave. The *crest* is the top of the wave. The *trough* is the bottom of the wave. *Frequency* is the number of times the wave crests in a given period. *Wavelength* is the distance between two crests. The *speed* of the wave is determined by multiplying the frequency times its wavelength. If the crest on one wave occurs at the same time and place as a trough in another wave they are considered *out of phase*. These waves can interfere with each other or even cancel each other out.

Sound travels in waves. Sound is created by the vibrations or the back and forth movement of objects. When an object vibrates, it sends sound waves off in all directions. However, sounds waves can only travel through mediums such as air, water, and objects. In other words, sound cannot travel in a vacuum. Sound waves travel at different speeds trough different mediums. The denser the material, the faster the wave travels. *Pitch* is the highness or lowness of a sound as we hear it. High-pitched sounds have a high frequency, and low-pitched sounds have a low frequency. Humans and animals communicate, or express their thoughts, by vibrating their vocal cords. Thicker cords vibrate more slowly and have a lower pitch. Similarly, the thicker strings on stringed instruments vibrate more slowly and produce deeper pitched tones. As boys get older, their vocal cords thicken and their voice drops. The intensity or the amplitude of the sound wave determines loudness.

Students learn how sunscreen can protect them from UV radiation

The sun emits electromagnetic radiation in the form of waves. This radiation travels out from the sun in straight lines in all directions. A small portion of this radiation reaches the earth. We see small portions of this radiation as visible light. Television signals, radio waves, X-rays, Ultraviolet rays, microwaves, and infrared radiation have wavelengths that are either too short or too long for us to see. Upon encountering an object, light waves can be reflected, refracted, or absorbed. When light is reflected, it is bent. The angle at which the light is reflected depends on the shape of the surface it is reflected from and the angle at which the light strikes the surface. Many objects that appear to produce light are only reflecting the light of another object. When light travels through a transparent object, it is bent or refracted. The shape of the object determines how the light is bent. Prisms, and sometimes water drops, bend light so that the different wavelengths are separated. Lenses bend light so that objects appear larger or smaller depending on the shape of the lens. Humans have created many different types of lenses that help us to explore and understand the world around us (Atwater et al, 1993).

Another way we perceive radiant energy is in the form of heat. Heat moves from one object to another by conduction, convection, or radiation. *Conduction* is the transfer of heat from one substance to another by direct contact. When either fast or slow moving particles touch one another, energy is transferred. Slow moving particles speed up, and fast moving particles slow down. *Convection* is the circulation of heat within liquids or gasses. Heating substances causes convection. When the particles begin to move faster, they get lighter and rise, allowing space for denser, cooler substances to fall. *Radiation* is the transfer of heat through open space in the form of waves. All warm objects emit heat waves or radiate (Utah State Office of Education, 2002).

Searching for birds during the "Sounds of Spring" activity

PRET-TRIP ACTIVITY

What is a Wave?

Objectives

Students will be able to:
a. Describe the characteristics of a wave.
b. Name three types of waves.

Materials

Slinky; four balloons; stereo; laser pointer; prism; mirror; black paper

PROCEDURE

1) Tell the students that they are going to be studying waves. Ask students to name as many types of waves as they can think of, and list these on the board. Make sure to include sound waves, light waves, and heat waves. Tell students that waves transfer energy from one place to another. Briefly describe, or ask students to describe, how each wave listed on the board transfers energy.

2) Tell students that the characteristics of a wave are determined by its shape. Ask for two volunteers to help you demonstrate. Give each student an end of a slinky and ask him or her to stand four to six feet apart. Have one person make one movement up and down. Discuss the wave and the motion, or direction, of the wave. Describe the properties of the wave (using the slinky for demonstrations and drawing on the board as necessary). Cover the terms *amplitude*, *crest*, *trough*, *frequency*, and *wavelength*. Have both students move the slinky and discuss the effects of wave interference.

3) Ask for four different volunteers. Give each volunteer a balloon and ask him or her to hold the balloon between his or her hands. Tell them that you are going to produce a wave and that you want to see if they can detect it with their balloon. Play a bit of music. Ask the students to describe feeling the wave. Ask the other students if they detected the wave. Discuss how the eardrums detect the vibrations of sound waves just like the balloons do. Tell students that deaf people sometimes are able to enjoy music by using balloons. Explain that sound travels trough different substances differently. Have four different volunteers hold the balloons and listen to music. Then have them put the balloons next to their ears. Have them describe the difference in the sound waves.

4) Tell students that light waves always travel in a straight line. Use a laser pointer to demonstrate. When light encounters an object, it can be bent, absorbed, or reflected. Have the students help you demonstrate by holding a prism, a piece of black paper, and a mirror. Ask students if anyone can tell you why we see color. Describe the combination of light reflection and absorption. Tell the students that radiant heat is another wave that we can detect with our bodies. Ask students to name sources of radiant heat. Discuss how different objects absorb heat at different rates. Ask the students to name some ways we can measure this absorbed heat.

5) Discuss what students need to bring on the upcoming field trip.

STATION #1

Whose Got the Heat?

Objectives

Students will be able to:

a. Name two characteristics of substances that absorb heat.
b. Describe why water can change the temperature of an object.

Materials

Surface thermometers; cups; clipboards; pencils; *Science Investigation Form* and *Heat Absorption Data Sheets*

PROCEDURE

1) Ask students to name a source of heat in the natural world. Discuss with students the path the sun's energy takes to get to the earth. Describe how much of that energy actually reaches our planet. Tell the students that heat from the sun travels through space in the form of waves. This is called radiant heat. Ask the students what happens to that energy once it arrives. Explain that some of it is reflected and that the objects on the earth absorb some of it. Objects that absorb heat then slowly transfer that heat through either conduction, convection, or radiation.

2) Tell the students that you are going to do an experiment to discover what objects absorb the most heat. Divide students into pairs. Give each pair a clipboard, pencil, thermometer, and *Science Investigation Form* and *Heat Absorption Data Sheets*. Have students begin to fill out their *Science Investigation Sheet* by writing down the question, "What objects radiate the most heat?" Explain the procedures, and show students how to aim their thermometer on objects, and then record their data. Have students list some possible locations for each of the given categories. Give students specific boundaries, and ask them to fill out their *Heat Absorption Data Sheets*.

3) Have students circle on their paper the three hottest objects they measure. Have each group present their top three objects and compare the temperatures. Have students name these objects in the "results" section of their investigation form. Discuss the properties of these objects, and have students write in the "conclusions" sections why the properties or locations of the objects made them radiate more heat. Have students pick the lowest temperature object they found in the sun, and discuss the properties of this object. Why did it not absorb as much heat as the other objects?

4) Ask the students what they like to do on a hot day. Explain that heat always moves to objects or areas that are cooler. When you swim you are giving your heat to the water through conduction. Pick two of the hottest objects you found. Take the temperature of the object, and pour water on it. Take the temperature again, and compare the results with the students. Explain that the water rapidly absorbs the heat, causing the temperature to fall. Ask students why the riparian corridor they are in is cooler, than other areas than the summer.

EXTENSION

In the hot sun, place a wooden bowl, a white plate, an iron pan, a plastic plate, some cotton cloth, and some lettuce leaves. On each of the surfaces, crack open an egg. Check on the eggs every five minutes until one of the eggs has fried.

Recording the temperatures of different surfaces

SCIENCE INVESTIGATION FORM

Whose Got the Heat?

Scientists' Names: _____ Date: _____

QUESTION

PREDICTION OR HYPOTHESIS

PROCEDURE

List step by step.

RESULTS

What actually happened?

CONCLUSIONS

What did we learn or what do our results mean?

HEAT ABSORPTION DATA SHEET

CATEGORY	OBJECT DESCRIPTION	TEMPERATURE
Something Brown		
In the sun	_____	_____
In the shade	_____	_____
Something White		
In the sun	_____	_____
In the shade	_____	_____
Something Green		
In the sun	_____	_____
In the shade	_____	_____
Something Hard		
In the sun	_____	_____
In the shade	_____	_____
Something Soft		
In the sun	_____	_____
In the shade	_____	_____
Something Wet		
In the sun	_____	_____
In the shade	_____	_____

STATION #2

The Sounds of Spring

Objectives

Students will be able to:

a. Identify at least one wetlands bird.
b. Name two reasons for a bird to sing.
c. Describe what determines the pitch of a birdcall.

Materials

International Migratory Bird Day poster (National Audubon Society and the U.S. Fish and Wildlife Service Division of Wildlife Refuges 1998); bird information and photo cards; a few copies of *Arches National Park Bird* checklists; binoculars; bird field guide; birdsong identiflyer with accompanying sound cards; a variety of bird calls

PROCEDURE

1) Discuss riparian areas as a resting area for migratory birds, using the *International Migratory Bird Day* poster as a prop. Ask students to name some reasons that birds migrate. Discuss the value of the Colorado River and its tributaries as a resting area on the Rocky Mountain Flyway. Ask students how birders might know a bird is near. Explain that sometimes a bird cannot be seen, but it can be heard. Ask students to name some reasons a bird might sing: call for mate, alert others to danger, tell others the location of food, for pleasure, check in with the flock, etc. Tell students that in all animals the pitch of the song or voice is determined by the size of the animal's vocal chords. For example, boys' voices change when heir vocal cords get thicker. Explain that birds have a syrinx instead of a larynx and that its size determines the pitch of the bird's song. Play a variety of birdcalls, and ask the students to predict which ones will be highest or lowest in pitch.

2) Show students the Arches National Park bird checklist, and explain how to extract information from it. Hand out a bird card to each student, and have each find his bird on the wetlands checklist. Give students a few minutes to prepare presentations: each will read his or her bird's name, show its picture, tell how abundant it is in each season, and read an interesting fact about the bird from the bird card. Have the student predict what the call of their bird might sound like. Play the call on the identiflyer, and discuss how the call differed from the student's prediction.

3) Review the properties of sound. Sound travels in waves. If we can figure out which direction the sound wave is coming from, it might help us to find the bird that is making it. Tell students that many things can absorb sound waves before they reach the ears of another bird, human or animal. Discuss what in the riparian area might absorb the sounds a bird makes. Ask students which calls would more likely be heard at a farther distance.

4) Pass out binoculars, and show students how to use them. Preface the bird walk with the need for no talking and quiet walking. Remind students that they are much more likely to hear birds than see them. Tell the students they are to keep track of how many different birdcalls they hear. Have students share their discoveries by pointing to birds, frogs, nests, or other things that they hear or see. Return to the spot where you started the station, and collect binoculars.

5) Ask students how many different calls they heard. Ask students why they were more likely to hear birds this time of day than they were to see them. Review the reasons that birds sing.

EXTENSION

Have students record bird songs in the same area for several days in a row. Students should chart how often particular calls were heard on each day. Compare to charts made by other students in other location. Have students hypothesize why different birds were heard at different locations.

STATION #3

UV or Not UV?

(adapted from Twiest &Twiest)

Objectives

Students will be able to:

a. define UV radiation
b. name three ways it affects humans
c. list three ways to protect themselves from getting too much UV

Materials

UV sensitive beads in cassette tape cases inside a covered box; extra tape cases; sunscreens of various SPF numbers *(no more than 2 years old)*; old sunscreen; science investigation sheets; UV posters (2); prism; permanent marker; clipboards; pencils, string, water, rags, scissors.

PROCEDURE

1) Tell the students they are going to be discussing UV radiation. Have them think back to their fifth grade field trip at the Island in the Sky and relate what they remember about UV radiation and the ozone layer. Remind students that UV radiation comes from the sun. Use a prism and the small poster to demonstrate how we can see different wavelengths of light when it is refracted and show students where UV falls into the spectrum, next to violet just out of our visual range. Since the wavelength of UV radiation is shorter than violet it has higher energy and thus has a greater effect on living organisms than other wavelengths of light. Living things are adapted to a certain amount of UV, and indeed it is necessary for life. But excessive UV radiation causes sunburn, eye damage, immune system suppression, and greater risk of skin cancer in humans. Because of depletion of the stratospheric ozone layer, scientists have been closely monitoring UV radiation since the 1990's.

2) Ask students how they protect themselves from getting too much UV, using the "Protect Yourself" side of the UV poster to illustrate. They can avoid UV by staying inside during the midday hours (10am-4pm), since it is greatest when the sun is the most direct. They can wear clothing that absorbs UV radiation before it reaches the skin like: wide-brimmed hats, long sleeves and pants, and sunglasses. Or they can put on sunscreen to reflect and absorb some of the UV radiation that reaches their skin.

3) Ask students if they have ever wondered how sunscreens work. Discuss what is meant by SPF. Sun Protection Factor numbers give an idea of how long your skin will be protected from burning. For ex., an SPF of 30 *may* give you 30 times longer in the sun without getting burned than if you hadn't put any sunscreen on, depending on your skin type and how much sunscreen you have applied. Ask students to figure out how long could you stay out in the sun with a sunscreen of SPF 30 if the UV index says you would get burned in 5 minutes without sunscreen,. Remind students that our bodies metabolize sunscreen every 2-3 hours. Discuss what that means for your skin if you forget to reapply, or do not apply enough sunscreen.

4) Tell students they are going to conduct an experiment to find out how well different sunscreens work using: UV beads, plastic cases, and sunscreens of different SPF's. Demonstrate how the UV sensitive beads change color when exposed to sunlight, then change back when taken out of sunlight. Work with the group to come up with a question and procedure for their experiment. Divide the students into pairs, giving each pair an experiment form to fill out in complete sentences. If students are having a difficult time, suggest the question "Which sunscreen reflects the most UV radiation?" A suggested procedure would include some variation of smearing the different tape cases of beads with different sunscreens, and then exposing them to the light. Tape cases should be marked, and there should be a control case with no sunscreen on it. Students may want to place a case in the shade, in the reflection of a water source, etc. Record data, and write conclusions. Have the students present their questions, procedures and results to the rest of the group.

Note

Keep the beads from the first group in the sunlight and discuss how the results have changed over the course of the day.

5) Review the definition and concerns about UV radiation. Have students stand so they can see their shadows. If their shadows are longer than their heights, they are receiving minimal UV. If the shadows are the same height or shorter than the person, as in midday, they should be protecting themselves from excessive UV radiation.

EXTENSION

Let students make bracelets for themselves using the string and 5 or 6 beads.

SCIENCE INVESTIGATION FORM

UV or Not UV?

Scientists' Names: _____ Date: _____

QUESTION

PREDICTION OR HYPOTHESIS

PROCEDURE

List step by step.

RESULTS

What actually happened?

CONCLUSIONS

What did we learn or what do our results mean?

STATION #4

Uses of Lenses

Objectives

Students will be able to:

a. Explain why humans would want to bend light.
b. Name three objects humans have created out of lenses.
c. Describe how one object with a lens works.

Materials

Bending Light poster; *Inside an Object* cards; seven objects with lenses(*corresponding to the inside an object cards*); clipboards; *Scavenger Hunt Sheets*; pencils; spoon; extra lenses; extra microscope; extra hand lenses; extra binoculars.

PROCEDURE

1) Point to an object in the distance, and ask the students to describe it. Ask them if there is a way for us to describe it in more detail without moving. Discuss why humans invented binoculars and telescopes and how these devices have aided the exploration of our world and universe. Next, pick up a single sand grain, and ask the students to describe it. Again, ask them if there is a way to describe it in more detail. Discuss why humans invented magnifying glasses and microscopes and how these devices have aided in our understanding of our world. Using the *Bending Light* poster and the spoon, explain that all these devices are possible because light bends when it passes through glass. The curvature of the glass determines how it bends, making an object look bigger or smaller. The lenses on our eyes do the same thing. Someone whose eyesight is not perfect has lenses that are either too flat or too curved. Have students name some other objects that humans have created to bend light: glasses, camera lenses, etc.

2) Give each student an object and an accompanying *Inside an Object* card. Have the students read the cards, study the pictures, and examine the object. Tell the students that you are going to give them a few minutes to figure out their objects and then explain it to the group. Give students 5-10 minutes to prepare their presentations. Answer individual questions as the students are working. Have the students each present their information to the group.

3) Divide the students into pairs. Tell them that they are going to go on a scavenger hunt. By using the lenses they have been discussing, they will be able to find everything on their lists without leaving the area. Hand out clipboards, *Scavenger Hunt Sheets*, and pencils. Instruct students to write down what they saw and what object they used to find it next to each category.

4) Have students turn in their pencils and lenses. Ask each pair to describe one of the things they found and how they found it.

EXTENSION

Tell students to pretend they are alone on a desert island with only a magnifying glass. Give students one minute to write down all the uses they can for the magnifying glass. Have each student write a short story telling how the use of the magnifying glass saved his or her life.

Exploring how lenses bend light

SCAVENGER HUNT

Use lenses to follow the directions in each box

Name: _____

Draw a living thing smaller than an eraser. What type of lens did you use to see details?	Draw the veins of a cottonwood leaf. What type of lens did you use to see details?
Locate a bird's home. Write a sentence describing its location. What type of lens did you use to find it?	What makes sandstone sparkle? What type of lens did you use to see details?
What shape is a sand grain? List five characteristics that make it different from the others. What type of lens did you use to see details?	Are there any petroglyphs in the area? If so draw them. What type of lens did you use to search?
Describe the legs of an insect. Draw what you see. What type of lens did you use to see details?	Can you spot any wild animals in the area? If so describe them. What type of lens did you use to search?

POST-TRIP

Can We Get Too Much?

Objectives

Students will be able to:

a. Name four instances where too much heat, light, or sound was harmful to humans.
b. Name two instances where too much heat, light, or sound was harmful to animals.

Materials

Too Much? cards; paper; pencils

PROCEDURE

1) Review the field trip with students. Discuss the properties of heat, light, and sound. Tell students that throughout history humans have produced their own heat, light, and sound. Often, the results are good. Ask students to point out some instances of artificial heat, light, or sound used in the classroom to help them learn. Explain that sometimes, however, artificial heat, light, and sound can cause harm. Sometimes, it is just too much of a good thing that has detrimental effects.

2) Divide students into groups of four. Each group needs to have a piece of paper numbered one through sixteen. Give each group a packet of *Too much?* cards. Tell the students that each card describes a situation where humans are producing heat, light, or sound. One person needs to read each card, and the group should discuss the situation. A different person should write down (next to the corresponding number) whether the situation will: cause harm to humans, annoy humans but not harm them, do only good for humans, cause harm to animals, bother animals but not harm them, do nothing to animals. Students should take turns reading and writing.

3) As a class, discuss the answers to each of the dilemmas. Discuss how some of the situations are good for humans but harmful to animals. Sometimes, humans do not even realize that what we are doing has unintended consequences. Discuss some instances where the value to humans might out way the harm caused to animals.

TOO MUCH? CARDS

1. Your neighbor leaves his car stereo on full blast. The sound is so great that it shakes your windows.

2. The army uses sound to map the ocean floor.

3. You use sonar to find fish in the lake.

4. A city is lit up by streetlights at night.

5. There is always a radio or a television on in your home, but the volume is turned on low.

6. You use a chainsaw to cut firewood.

7. Spotlights light up an object throughout the night.

8. You hear fifteen different airplanes while you hike in a local national park.

9. Semi-trucks speed near your neighborhood going 55 miles an hour.

10. Two students are talking in class during a silent reading period.

11. A mother sings softly to her baby.

12. A large parking lot is covered with blacktop; there are no trees.

13. Campers build a large campfire under a tree.

14. A home is heated throughout the winter using a woodstove.

15. You and your friends spend an entire night shinning your flashlight on sleeping creatures.

16. You help a friend produce a fireworks display on the Forth of July.

References and Resources

Atwater, M., Baptiste, P., Daniel, L., Hackett., et al. (1993). *Wave energy: Teacher's planning guide*. New York: Macmillan/McGraw-Hill Science.

Hartshorne, C. (1992). *Born to sing.* Bloomington, ID: Indiana University Press.

Sherwood, E., Williams, R., & Rockwell, R. (1990). *More mudpies to magnets.* Mt. Rainier, MD: Gryphon House.

Twiest, M. & Twiest, M. (2004) *The scoop on sunscreen*. Science and Children. V 41. N 9. Summer. pp 40-41.

Utah State Office of Education. (2002). *Teacher resource book: Grade six.* Salt Lake City: Author.

"What is UV?" and "Ultraviolet Radiation" (E.C. Weatherhead) http://www.srrb.noaa.gov/UV/what.html.

Ultraviolet Radiation Fact Sheet http://earthobservatory.nasa.gov/Library/UVB/uvb_radiation3.html

Choose Your Cover Skin Cancer Prevention Campaign http://www.epa.gov/chooseyourcover/qanda.htm

SunWise Kids http://www.epa.gov/sunwise/kids/kids_uvindexPrint.html